The Chemical Age

A Weekly Journal Devoted to Industrial and Engineering Chemistry

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Science and World Order

IT is always difficult to assess the true value of conferences, that held last week by the British Association being a good example. Conferences serve as a safety valve through which are ejected the pent-up thoughts of those who take part in them. But our experience is that their ultimate value is small unless they give rise to positive action. There must be some driving force to gather up the conclusions and carry them along into the sphere of action. This conference will have failed to create more than a ripple on the already disturbed surface of the world unless there are to be found among the scientists, politicians, ambassadors, and others interested in the subject one or more individuals with the driving force and the power to translate the lessons of the conference into action.

What were the outstanding lessons? It cannot be said that they were new to those who have eyes to see and ears to hear. So seldom, however, do those immersed in research, in teaching, or in industrial production lift up their eyes to see or their voices to ask; that we shall do well to inquire audibly what conclusions may be reached in order that we may perchance discover from them along which way we are travelling. We may perhaps neglect the obvious. Among these are Dr. Huxley's summary of the results of the conference. He supposed that it might lead to London becoming the scientific centre of the world. He found that there had been universal agreement, impossible 20 years ago, on the practical importance of scientific discovery for implementing human needs and aspirations. That has come about because the discoveries of science have been put into practical action—a significant fact that we commend to all would-be world planners. There was also agreement on the necessity for the utilisation of science and scientific technique in the post-war period. These things are already accepted; the only problem is how best to make use of the knowledge we possess in the post-war world, bearing in mind the fact that scientific knowledge is not static and that Science sometimes finds it necessary to retrace its footsteps as knowledge widens.

We may also neglect the Charter of Scientific Principles that was enunciated, not because there will not be general agreement with its provisions, but because it is little more than the scientific man's rewriting of the more famous Atlantic Charter. The basic fact is that Science is somewhat in the position of the Early Christian Church. Power rests with politicians and governments and unless the governments subscribe fully to the B.A. Charter and put its provisions into practice the scientific man will be persecuted for his pains unless he does what his government orders him to do. It is to establish such charters that the whole world outside Germany, Italy and Japan, is fighting.

A positive achievement of the conference, however, was to lay emphasis on the close relationship which now and in the future must exist between science and government. If that fact gets firmly into the heads of the free governments of the world, it will be scientists' own fault if they do not retain for all time that freedom of thought and scientific action which is already theirs outside the Continent of Europe. There may be still some "obstructive traditionalism" particularly from those whose education has lacked a scientific basis, and that will not be removed by charters, but by the spread of real education.

Perhaps the most important conclusion reached by this conference is that science must in the future concern itself as much with the consumer as in the past it has concerned itself with the producer. Since the Victorian scientist lugubriously prophesied world food shortages if the population were suffered to increase, science has been primarily a productive force—" to make two ears of wheat grow where one grew before." The chemists and physicists associated with manufacturing firms, the productive agencies, have recognised the importance of the consumer. Fertiliser manufacturers assist farmers to use their product, gas engineers advise on gas utilisation, coal owners on coal utilisation, and so the list might be indefinitely extended. But many of the producers do not and cannot exert any such direct influence on the consumption of their products. It has been shown that if scientific standards of nutrition could be laid down, standards which are no more than the necessary minimum for human well-being, and if those standards could be generally enforced by the governments of the world, there would be no talk of agricultural depression, nor of over-production. A chronic pre-war complaint of every agricultural country in the world would be swept away. Similarly, there must be scientific standards of clothing, housing, leisure and so forth to which every human being should be entitled in a scientifically-organised world.

What is true of agriculture, therefore, could be made true in a scarcely less degree of industry. It must be the task of science to raise the general standard of living by setting up properly deduced minima below which all governments, including those of the East, must agree not to allow their peoples to fall. Science must now labour to substitute an organised expansion of consumption for the unorganised expansion of the past years. The science of consumption must take precedence of the science of production.

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NOTES AND COMMENTS

A Charter for Science

THE big guns have spoken, and Science is to have its Charter. This is the entirely satisfactory outcome of the international scientific conference, organised by the British Association, which was held in London last week. Presided over at the opening session by Sir Richard Gregory, the conference was honoured by the presence of many distinguished men outside the field of Science, as well as within it, and the Ambassadors of the United States, the Soviet Union, and the Republic of China and the President of Czechoslovakia all contributed wise words to the symposium. M. Maisky, who took the chair at the third session, struck a definite note of realism. Being in fact better qualified than anyone else present to speak on the subject of planning—as he said, planning is the very foundation of the economic life of his country—he pointed out that for world planning on the scale contemplated by the conference, a number of prerequisites were essential. The first of these was the crushing of Hitlerite Germany. The Seven Principles of the Charter, announced by Sir Richard Gregory at the final session, will undoubtedly be subscribed to by every scientist of good will; and it is high time that some such set of international principles was laid down. But we have an uneasy feeling, which we know is shared by many practical scientific workers, that there is a tendency abroad, in certain quarters, to put the cart before the horse. Professor Julian Huxley countered this criticism by pointing out, in effect, that there was no harm in considering what sort of cart the horse was to draw; and we agree with him, provided that the principle "first things first" is not lost sight of. Scientists and others may well remember two famous men and their oft-repeated sayings in two previous wars to the death: Cato the Elder, with his "*Delenda est Carthago*," and Clemenceau with "*MM. les Allemands sont toujours à Noyon.*"

Chemical Progress on View

INNOVATIONS in the application of chemical processes, in greater number than on any occasion since the last war, will be made available through the activities to be revealed at the forthcoming (18th) Exposition of Chemical Industries, which is to be held at the Grand Central Palace, New York City, on December 1 to 6 this year. For this statement we have the authority of Mr. Charles F. Roth, who has managed all these exhibitions since they were started in 1915 and should therefore be qualified to express an opinion. Stimulated by the present emergency, he says, the chemical industries of America are undergoing the most rapid expansion in history, and exhibitors have made a record response to the organisers' appeal. Included among the exhibits will be many illustrating how, as "defence production" approaches full-blast operation, the chemical industries are bringing forward answers to problems which have never before been solved commercially. It is to be hoped that a certain number of observers from the British chemical industry will be allowed the opportunity to inspect these proofs of industrial chemical progress on the other side of the Atlantic. A close liaison, we know, has been officially established between the scientists and technologists of Britain and the United States, but it would certainly do no harm for a team of practised and practical industrial chemists to pay a visit to the Exposition. It might be possible for them to arrange an exchange of seats in the Clipper with some of the film stars and others whose transoceanic oscillations are so interesting a feature of the "present emergency."

Leaded Steels

THE use of leaded steels for the production of machined parts is claimed to be one of the greatest developments of steel in recent years. Its use can enable machined steel parts to be produced at an increased speed of from 30 to 100 per cent. above the normal. Such material was first introduced in the United States, but research has made greater progress in this country than in America—probably on account of the great need here for maximum production—although the native caution of the British steelmaker may account for some hesitation in the use of leaded steels. A widespread impression is that the addition of lead to steel affects physical qualities adversely. The authority of practical metallurgists, however, is quoted for the assertion that physical properties are not impaired and that neither tensile strength nor welding qualities are affected. The addition of lead to brass and bronze was undertaken many years ago, but difficulties were met in regard to steel. These have been overcome, and it is possible to put lead to an approximate amount of 0.25 per cent. into steel of almost every quality. In that condition steel contains lead so finely dispersed that it cannot be seen under the microscope, and in this respect it differs from brass and bronze, in which the lead is visible in globules under the microscope. Steels of this kind have been produced in this country since the beginning of 1939. They were originally developed in the United States of America, and commercial production began there early in 1938.

Chrome Shortage in the Axis

THE suggestion made in some quarters that the supply of chrome ore to Germany was shortly to be increased by exports from Turkey does not now seem likely to be well-founded. It is, in fact, understood that M. Sarajoglu, the Turkish Foreign Minister, has informed the German envoys, Clodius and Papen, that Turkey will supply no chrome ore to Germany. Turkey produces about 200,000 tons of chrome ore per annum, approximately one-fifth of the total world production. Greece and Yugoslavia between them raise some 90,000 tons (all of which is now available to Germany, of course) and Russia is likewise a large producer. Until the Nazi invasion of Russia, Germany was an importer of chrome ore from Russia, but with their available sources now restricted to the Balkan product, the Nazis are doubtless feeling the lack of this important war material. Not only is chromium essential for the toughening of steel for many purposes, but its compounds play an important part in the pigment, tanning, and dyestuffs industries. British supplies of the material are well assured so long as the sea route to South Africa keeps open.

"Owing to the present situation" the September number of the *Alloy Metals Review*, issued by Messrs. HIGH SPEED STEEL ALLOYS, LTD., Widnes, has been restricted to the publishing of short abstracts.

Recovery of Used Lubricating Oil, II

Operating a Central Plant

by J. E. WALKER

(*Continued from* THE CHEMICAL AGE, *September 20, 1941, p. 156*)

THE second type of recovery is carried out at a central plant, designed for the purpose, to which the oil is brought, having been collected over perhaps a fairly wide area. For successful results, the plant should be controlled by experienced technicians. Three main types of treatment are open for consideration by a concern such as this, and are as follows: 4, Vacuum distillation, followed by chemical refining as may be necessary; 5, high-temperature clay treating; and 6, acid/clay refining.

The fourth type of treatment must obviously be the best, since the result will be a range of new products; but since it is merely a duplication of normal refinery practice, and even on a small scale, comparatively very expensive, it will not be considered here.

High-Temperature Clay Treatment

The fifth method is an improved way of carrying out reclamation as described under method three, and is carried out as follows: A closed vessel, fitted with vapour outlet and condenser, is charged with pre-settled oil, and the requisite amount of clay added. The vessel is fitted with a coil for the delivery of live steam to the charge, and some jets of steam should impinge downwards on to the still-bottom, to prevent the clay caking, since in this process it is usual to rely on the steam for agitation. If required, mechanical agitation can be used as well. The vessel can be heated by any convenient method and, when treating, the temperature of the clay/oil mixture is raised to some point predetermined by laboratory experiment, but usually falls between 250° and 300° C. During the whole of the heating above 150° C., steam is blown through the charge.

When the finishing temperature is reached, heating is discontinued, but steaming should be continued until the charge has cooled to about 200° C. If found necessary, the charge may be held at this upper temperature for 15 to 30 minutes, while steaming continues, thus ensuring that all vaporisable products formed up to the maximum temperature are completely removed. This will improve the flash-point and odour of the finished oil. The oil is then passed through a filter-press at a temperature of 150° to 200° C., according to its viscosity. The lowest convenient temperature should be chosen for this operation, to lessen the risk of oxidation and hence an off-colour oil.

By this method very excellent results should be obtained, and while some laboratory control is necessary, wide technical experience is not required. The higher temperature of reaction leads to greater activity on the part of the clay, and hence a more thoroughly refined product. The steam provides agitation, prevents oxidation of the charge, eliminates all light ends causing dilution, and drives out traces of compounds which usually cause an unpleasant smell in recovered oils that have not been steamed. The finished product is completely free of all suspended matter; soluble sludges and saponifiable matter greatly reduced, and acidity should be quite removed. The flash should be practically normal for the grade of oil treated, indicating practically no dilution, while colour and odour should be satisfactory. The weakest features of such an oil will still be colour and stability, but the improvement is so marked that the product should be saleable for many types of lubrication.

The Best Usual Method of Recovery

Of the methods usually considered for the recovery of used oils, the sixth on the list, utilising sulphuric acid, clay, and steam, gives by far the best results, and is carried out in the following manner: The oil is first settled in storage tanks, preferably warmed. This settling treatment should be thorough, since the presence of water leads to dilution of the acid, and hence to incomplete acid treatment, with a poor finished oil. Failing adequate settling, more acid must be used, preferably in two successive treatments. Thus proper settling will lead to more economical recovery. The settled oil is run to an acid-treating pot fitted with mechanical agitator and small steam-heating coil. Here it is treated with from 3 per cent. to 10 per cent. by weight of sulphuric acid (sp. gr. 1.84), the requisite amount being found by experiment. The temperature of treating depends on the viscosity of the oil, but should rarely, if ever, exceed 40° C.; the length of treating depends greatly on the efficiency of the agitation, but one hour should usually prove sufficient. Treating should be adequate and thorough, but it must be remembered that high treating temperatures and long treatments always increase the risk of oxidising the charge, and so spoiling the batch.

After acid treatment the sludge is allowed to settle either in the treating pot or in another vessel used for this purpose, according to the plant available and the throughput desired. The time required for settling varies with the viscosity of the treated oil. Thin oils are often ready for the next stage after four hours' settling, while very viscous oils may require 48 hours. To aid settling temperatures up to 60° C. can be used, or small proportions of water or starch solution added some five minutes before the acid treating is completed. These "additives," when mixed with the sludge suspended in the oil, coagulate it, and when the agitation is stopped the sludge settles much more rapidly. The whole of the acid-treating process, if first class results are required, should be laboratory controlled, and the treating carried out by experienced operatives.

When settling is complete, the oil should be run off the sludge as soon as possible, otherwise the oil may suffer a colour "throwback," and the finished product will be unsatisfactory. The acid-treated oil is now run to a still, and treated in exactly the same way as in method five, and finally run to storage.

Superiority of Recovered Oils

Whenever a method of reclamation is adopted using steam and high temperatures, *e.g.*, number five or six, a small storage tank should be provided for the distillate obtained. This can frequently be worked up and sold as a light diesel fuel. Provided that all the steps in such a process are carefully carried out, the resulting recovered oil should be equal in every respect to a new oil of similar grade. In a number of cases, oil recovered by such a method has proved a better product than the original oil. This statement may sound improbable to the layman, and it has proved difficult to convince prospective buyers of these oils of such a fact: yet a consideration of the composition of oil, the uses to which it has been put, and the various forms of deterioration it has suffered, will show that this is the result to be expected.

Thus the new oil, as we have already seen, is a mixture of various hydrocarbons and, in the very nature of things, some of these hydrocarbons will prove less stable in service than others, and hence will deteriorate first. The amount of these more unstable hydrocarbons depends chiefly on the quality of the lubricating oil, but just because such oils are mixtures, some portion will break down first. In spite of constantly improved methods of preparation, this will probably be the case as long as lubricating oils are mixtures. So, in use, these unstable elements will be the first to decompose, leading to all the impurities already mentioned. This used oil is now retreated, and turned out as a new oil, less the unstable elements which have already broken down. Hence the recovered oil must obviously be a more stable product than

the original, since the more easily decomposed bodies have already been destroyed and their products removed. Obviously the cycle will begin all over again, but the recovered oil should last longer under the conditions imposed on the original oil, or will stand up to more severe treatment. Research and experiment have proved this to be the case. In fact, it is quite possible with good used oil, to produce lubricants which will pass the stringent tests of the Air Ministry, when the original oil would not meet this specification. It should not be inferred from the foregoing that any used oil can be turned out better than its original, or equal to aero-engine oils; and here, in the author's opinion, is the chief difficulty of the whole business, *i.e.*, the supply of raw material, and its proper classification for treatment.

It is here that the reclamation of oil by its user has its one advantage. In such cases the grade, analysis, and composition of the new oil are known, and also its history in use. The operators know to what use the reclaimed oil will be put, and control their scheme of recovery accordingly. Those operating a central recovery plant have no such simple problem. They can roughly separate thick oils from thin, and comparatively clean oils from obviously dirty ones, but that is about their limit.

Control of Crank-Case Drainings

Crank-case drainings, as will be obvious, are of very mixed origins. Paraffin, naphthenic, and asphalt-base mineral oils will be present, together with varying amounts of solvent-refined, synthetic, hydrogenated, and fatty oils. From such mixtures it will be impossible to produce standard products regularly by reclamation. While the varied oils produced prove quite marketable, the usual solution is somewhat different. The various batches of used oil are treated to yield the greatest quantity of good oil possible, and then, by blending this oil with either spindle oil or bright stock, a fairly complete range of lubricants can be produced. This naturally will involve laboratory control, but the resulting oils should be equal in every respect to new oils of similar grades.

Before concluding, there are two points to be noted: (i) the possible presence of fatty oils in the used oil collected for re-refining; and (ii) the effect on reclamation of additives which may have been present in the original oils. With reference to the first point, wherever possible used oil containing oils of animal, vegetable, or fish origin should be kept separate, and reclaimed separately. Otherwise it will prove exceedingly difficult to obtain as finished products oils of good stability and odour. Those batches of used oil containing fatty oils should be given a preliminary wash with caustic soda solution. Usually about 50 per cent. by volume, based on the oil being treated, of a 1 per cent. to 2 per cent. solution of caustic soda in water is used, and the oil and soda solution thoroughly mixed together for about 15 min. at a temperature of 60° to 80° C. After settling, the washed oil may be treated in any of the usual methods described, and good results obtained.

Effect of Addition Agents

Regarding the second point, questions have been raised as to whether the presence of addition agents in the original lubricants will effect reclamation, and whether any of these addition agents will be present in the recovered oil. These additives, which are now frequently blended with lubricants to improve film-strength, oiliness, stability, viscosity, and similar features are present in only small percentages. Except in special types of oil, the maximum amount of additive will rarely exceed 2 per cent. by weight of the oil, and in most cases will be under one per cent. They are mainly organic substances carrying one or more of the elements sulphur, chlorine, phosphorus, and nitrogen, and metallic soaps such as tin oleate and lead naphthenate. These substances are of varying degrees of stability, and some will most probably be present in used oils, but in such small quantities it is unlikely that they would have any effect on reclamation whatsoever. Some will undoubtedly be removed by thorough reclamation, *e.g.*, the metallic soaps. Others such as chlorinated paraffin wax would probably survive. In any case it would be fairly safe to ignore their presence in recovered oils.

Where an organisation is fully equipped to carry out complete recovery and can obtain large supplies of one grade of used oil, originally of high quality, as is sometimes possible from large haulage contractors, machine-shops, or airway companies, the problem of re-treating is greatly simplified. Such circumstances usually result in the best recovered oils, and very frequently the recovered product is of higher standard than the original new oil.

In the accompanying table figures are given showing the results of tests carried out on a new oil, the same oil after use, and after reclamation by the various methods that have been outlined. The figures should be taken only as an indication of what can be achieved, but are based on actual experimental results obtained. From these figures it will be seen that best results were obtained using the acid-clay-steam process, and, in the author's opinion, this is by far the best method. It has been suggested that vacuum can be used in place of steam in the various methods, and indeed excellent results can be so obtained. However, apart from its higher cost of installation, it cannot take the place of steam as a sweetening agent; neither can it be used for agitation.

Treating Costs

Treating costs for the acid-clay-steam process are quite moderate. Taking sulphuric acid at its present price of approximately £7 per ton, and high grade decolorising clay at £20 per ton, the cost of treating a ton of used oil with 5 per cent. by weight of acid, followed by 5 per cent. by weight of clay, will be about twenty-seven shillings. Taking a ton of used oil as being 250 gallons, the treating losses might be 20 per cent., *i.e.*, 10 per cent. by vol. of dilution, and 10 per cent. by vol. of acid sludge. This will leave some 200 gallons of finished oil treated at a cost of about 2¼d. per gallon. To this figure must be added heating and labour charges, and the cost of collection of the used oil. Naturally, these figures will vary considerably, but they can be taken as a fair average.

There are many additions and refinements in treating which could be included, but the broad outlines have been given, and more detailed processes depend on individual requirements. Thus it can be seen that there are, in the satisfactory recovery of used oil, no serious problems that trained operators cannot overcome. The main difficulties would appear to be in obtaining regular supplies of used oil, in grading it for treatment, and in overcoming the prejudice existing against the use of recovered oils. Any organisation that considers itself to be in a position to overcome these obstacles successfully should have no difficulty in building quite a substantial and interesting business, and it is amazing that so little has been done in this country along these lines.

The matter is, to the author's knowledge, now receiving more attention, but there is probably a future for quite a number of such plants in this country, and after the war there should be considerable scope on the Continent.

Canadian Salt Production

Soil Stabilisation Market

CANADIAN salt production continued to increase in 1940, when it totalled 464,714 tons, valued at $2,823,269, as compared with 424,500 tons, worth $2,486,632, in the preceding year. The greater part of the output came from wells in S.W. Ontario. Soil stabilisation with salt and clay for the foundations of highways, and also the development of soil-stabilised bases for runways at Canadian airfields have opened up a new market for salt. Almost forty per cent. of the salt production is used in the form of brine by the chemical industries for the manufacture of caustic soda, liquid chlorine, and other chemicals and in this direction the demand for salt may be expected to increase as, with the exception of caustic soda, soda ash, sodium sulphate, sodium silicate, and acid sodium sulphate, nearly all the sodium compounds used in Canada are imported.

New Standards for Aqueous Solutions

Nitric and Hydrochloric Acids

THE British Standards Institution is about to issue two new sets of tables giving the density composition for aqueous solutions of nitric acid (B.S. 975) hydrochloric acid (B.S. 976). Similar tables have already been issued for sulphuric acid, sodium chloride and calcium chloride, and caustic soda, and were prepared primarily for use in conjunction with British Standard Density Hydrometers (B.S.718). The hydrometers and tables together provide a simple means of determining the strength of aqueous solutions or of making up a solution of known strength. The underlying principle of the scheme is that it is the function of the hydrometer to determine the density of the solution at the temperature at which the reading is taken, and that it is the function of the tables to correlate density with composition and from the density determined at any particular temperature to enable the density and composition of the solution to be determined for any temperature within the range of the tables.

Appendices to the tables give details of the British Standard density hydrometers available; a note on the reading of hydrometers in these solutions, examples of the use of the tables in conjunction with British Standard density hydrometers and details of corrections to readings taken.

Although the tables are primarily intended for use in conjunction with British Standard density hydrometers, since the composition of aqueous solutions of hydrochloric acid have been correlated directly with density, they may be used in conjunction with any method of determining density. The general adoption of British Standard density hydrometers and the use of density-composition tables in conjunction therewith would lead to a much needed unification and simplification of hydrometry in scientific, technical and industrial work.

The British Standards Institution will welcome suggestions for the preparation of tables for other liquids of industrial importance. Copies of B.S. 975 and 976 may be obtained from the Institution, 28 Victoria Street, London, S.W.1, price 3s. 6d. each (3s. 9d. each post free).

Raw Materials in Sweden

Serious Shortage of Coal and Rubber

ACCORDING to a September summary of the position of raw materials in Sweden, published by the *Anglo-Swedish Review*, it is stated that in respect of chemicals the situation is very varying. Current imports of salt, soda and Glauber's salt have proceeded according to plan. The requirements of sulphuric, nitric, and hydrochloric acids and of alkali are wholly covered by domestic production. A pronounced shortage exists in the matter of some tanning materials, but the stocks are eked out with tanning preparations from native raw materials. Hardly any flax seed or linseed oil has been arriving in Sweden, necessitating strict rationing of linseed oil. Certain substitutes are used in the manufacture of paints, but the shortage of linseed oil had hit the manufacture of linoleum floorcloth very hard. In spite of the appearance of substitutes of different kinds and the lowering of the fatty acid percentage in soap, it was found necessary in spring last year to ration the consumption of washing mediums.

There is a shortage of lubricants, and the present consumption has had to be restricted to about 60 per cent. of normal. Strong efforts are being made by the Swedish authorities to replenish supplies through importation and, in addition, attempts are on foot to start production of lubricants on the basis of native products, such as shale oil and wood tar. Rubber is also very scarce. The use of crude rubber has been cut down to one-half, and will be further reduced; it is hoped to make more regenerated rubber available.

As regards other industrial material, the rationing of coal and coke has been stringently enforced this year. In May, the total coal consumption by industry was reduced to one-third of the normal monthly consumption in 1939, and it has been further cut down during the summer. The cement industry had been hit particularly hard by the shortage of coal, being a very large consumer of fuel in relation to its production.

Ferrous and Non-Ferrous Metals

The output of steel during the first half of tnhis year did not quite attain the quantity estimated by the Industrial Commission as being required for covering the year's requirements. The supply of commercial steel was liable to shrink owing to a shortage of pig iron and scrap, while the situation in respect of quality steel was easier on account of the present elimination of several of the most important export markets for Swedish steel. This in itself unfavourable development had lightened the situation for domestic consumers.

The supply of copper is limited, and agreements have been concluded for increasing the domestic production of copper by about one-third. Strict economy was also necessary with regard to aluminium, although it had been possible to keep the stocks fairly constant through imports from Norway and Switzerland and through domestic production. A new aluminium factory using Swedish andalusite as raw material will be started next year with State support. The domestic production, however, is dependent on certain reagents and raw materials that lately have proved difficult to obtain.

The stocks of tin on hand are relatively large, but the prospects of obtaining any fresh supplies from abroad are practically nil. Stocks of lead are small, and the situation on this score unsatisfactory. Increased lead mining is projected with Government assistance. The prospects of importing zinc are brighter, and production of this metal may also be started in Sweden.

Chemist's Summary Dismissal

Ordnance Factory Criticised

THE dismissal of a chemist at a Royal ordnance factory after he had complained to members of Parliament about alleged inefficiency at the factory and written an article about it, is being taken up by the Association of Scientific Workers.

Mr. E. D. Swann, an executive member of the Association, referring to the incident at the British Association conference in London last week, remarked that "this revealed a state of affairs in which the existence of incompetent control had to be concealed by the use of extreme measures.

Mrs. Ryerson, assistant secretary to the Association of Scientific Workers, has made a statement pointing out that the chemist, Mr. Clark, first complained of inefficiency at the factory at a Fabian summer school in August. He later wrote a letter, which was signed by ten out of fourteen chemists, and sent to the management. Their reply put the blame on the shift chemists. Mr. Clark then sent an account of the negotiations to two members of Parliament and to the Chairman of the Select Committee on National Expenditure, and wrote an article for a weekly journal. A couple of weeks ago he received a letter summarily dismissing him on grounds of inefficiency. He is appealing against the dismissal.

Broad powers are given in the recent order appointing a Controller of Chemicals in Canada. The Controller was appointed so that no shortages of essential chemicals, constituents, or intermediates might develop, and to take measures to assure a supply of chemicals required for war needs. The office of the Chemical Controller will be in Montreal. The Controller is empowered, among other things, to acquire chemicals and equipment and to enter any plants or buildings in search of such chemicals and equipment. He may, subject to the approval of the Minister of Munitions and Supply, fix or regulate prices and limit sales.

New Chairman of Benn Brothers, Limited

Mr. Gordon Robbins Succeeds Sir Ernest Benn

SIR ERNEST BENN has resigned his position as Chairman of Benn Brothers, Ltd., proprietors of THE CHEMICAL AGE, and Mr. Gordon Robbins has been elected in his place. When in 1934 Sir Ernest Benn accepted the chair of the United Kingdom Provident Institution, he relinquished his managerial functions in Benn Brothers and has since held only an advisory position. The increasing pressure of insurance work and heavy demands from the literary field have hastened a change which in any case could not have been delayed for long.

Mr. Gordon Robbins is only the third chairman of the sixty-year-old publishing business of Benn Brothers, the first being the late Sir John Benn, and the second the present baronet. Mr. Robbins, who has been deputy chairman since 1927, is a former Day Editor of *The Times*, and has just been elected President of the Institute of Journalists for 1942. He is Treasurer of the Newspaper Press Fund. Sir Ernest Benn will continue to occupy a seat on the Board of Benn Brothers and to act in a general advisory capacity to the business which he joined in 1890 and has served ever since.

Mr. Gordon Robbins

Sir Ernest Benn, in a message to the staff of Benn Brothers, says: — "Seven years ago, when I was selected for the responsible headship of a great insurance office, I handed over to my deputy, Mr. Gordon Robbins, the bulk of my work at Bouverie House and have since been Chairman of the Company in name rather than in working fact. A daily consultation on questions of policy has been the extent of my contribution to the success of the firm and, at the special wish of all my colleagues on the board, that daily consultation will continue. I resign the chair but remain a member of the board; and I am thus relieved of anything in the nature of a farewell message to the staff. In so far as I have succeeded in building up this business from one small monthly to its present impressive proportions, it has been chiefly due to my good fortune in selecting and securing a great body of colleagues who now stand out in the very centre of Fleet Street as representative of all that is best in journalism, in publishing, and in business.

"I need not ask for the friendship and loyalty so freely given to me to be transferred to my successor, because for years past he has shared those joys with me. Neither will he desire that I should cease, though in diminishing measure, to share those joys with him. I should perhaps add that the change of position is made at my request; the suggestion was initiated by me alone. The whole profession of journalism is to-day congratulating Mr. Gordon Robbins on his election as President of the Institute of Journalists. It is thus timely that we should add our congratulations on his assumption of another honoured title, 'Mr. Chairman' of Benn Brothers, Limited."

Personal Notes

DR. P. CHISHOLM YOUNG has been appointed plastics engineer with Boulton Paul Aircraft, Ltd.

MR. R. H. ROBERTS is now acting works manager with the British Tin Smelting Co., Ltd., in Lancashire.

MR. C. V. TRELOAR, director of Swift and Co. Pty., Ltd., has been admitted as an Associate Member of the Australian Chemical Institute.

MR. J. GILLET has been appointed a chemical engineer with I.C.I. (Dyestuffs), Ltd., in the Plant and Operating Section of the Research Department.

CAPTAIN J. T. YOUNG, Ph.C., A.I.C., of the Royal Army Ordnance Corps, is a prisoner of war in Germany. He was demonstrator at Birmingham Technical College from 1937 to 1939, and joined the Forces in February, 1940.

MR. J. E. TRIGGS, late of the Staveley Coal and Iron Co., Ltd., has joined the outside technical staff of Clapham Brothers, Ltd., Gas, Chemical, and Constructional Engineers, of Keighley, Birmingham, and Paisley

MR. L. A. R. STEDEFORD has been appointed a director of Stewarts and Lloyds, Ltd. He is managing director of Tube Investments, and is on the boards of several important tube-producing companies, as well as a director of Reynolds Rolling Mills.

Obituary

MR. HARRY STANDISH BALL, O.B.E., M.Sc., F.G.S., Principal of the School of Metalliferous Mining, Camborne, Cornwall, died at Haslemere, on September 26, aged 52. Mr. Ball was educated at the Witwatersrand University, Johannesburg, and at McGill University, Montreal. He was a member of the Institute of Mining and Metallurgy and a Fellow of the Institute of Petroleum and was well known both as a mining engineer and a petroleum technologist.

New Control Orders

Coal Tar Acids

THE Secretary for Mines has issued a direction in respect of coal tar acids which will come into operation on October 13. Under the direction no "distiller" or "importer" may dispose of coal tar acids except under the authority of a licence. Coal tar acids for the purpose of this direction are defined as follows:—"The constituents of coal tar or of the distillates from coal tar which are soluble in aqueous caustic soda solution, and cresols and xylenols derived from any source other than coal tar." This direction excludes phenol, and phenol mixtures, containing more than 80 per cent. of phenol, the disposal of which was brought under licence by means of a direction which came into operation on April 14 (*see* THE CHEMICAL AGE, April 12, 1941, p. 208).

Compound Fertilisers

Under a new Fertiliser Control Order (No. 14) which came into force on October 1, farmers will be able to purchase compound fertilisers for delivery further ahead than 60 days. A direction in the Order permits the purchase of potash for various crops, its availability being governed by the position of supplies.

NEW DIPHENYL PREPARED

Preparation of pure 2′-nitro-2-aminodiphenyl has been achieved by Donald Purdie, of the Department of Chemistry, Raffles College, Singapore (*J. Am. Chem. Soc.*, 1941, *63*, 2276). Ethanol (600 c.c.) and 2,2′-dinitrodiphenyl (42 g.) were boiled under reflux condenser and a solution of sodium polysulphide (prepared by boiling 12 g. sulphur with 48 g. sodium sulphide crystals with 150 c.c. water until dissolved) slowly added. The solution turned green and then orange; boiling was continued for three hours and the whole allowed to stand overnight. Most of the ethanol was then removed by distillation and the residue poured into 1 litre of ice water. The product was extracted with ether and the ethereal solution washed with water and then dried over caustic soda pellets to remove impurities. After removing most of the ether the rest was cooled and the 2′-nitro-2-aminodiphenyl then separated as indistinct crystals. Thrice recrystallised from ethanol the final product (m. p. 94-94.5°) formed orange needles easily soluble in ether or benzene, sparingly in cold ethanol or petroleum ether.

Metallurgical Section

Published the first Saturday in the month.

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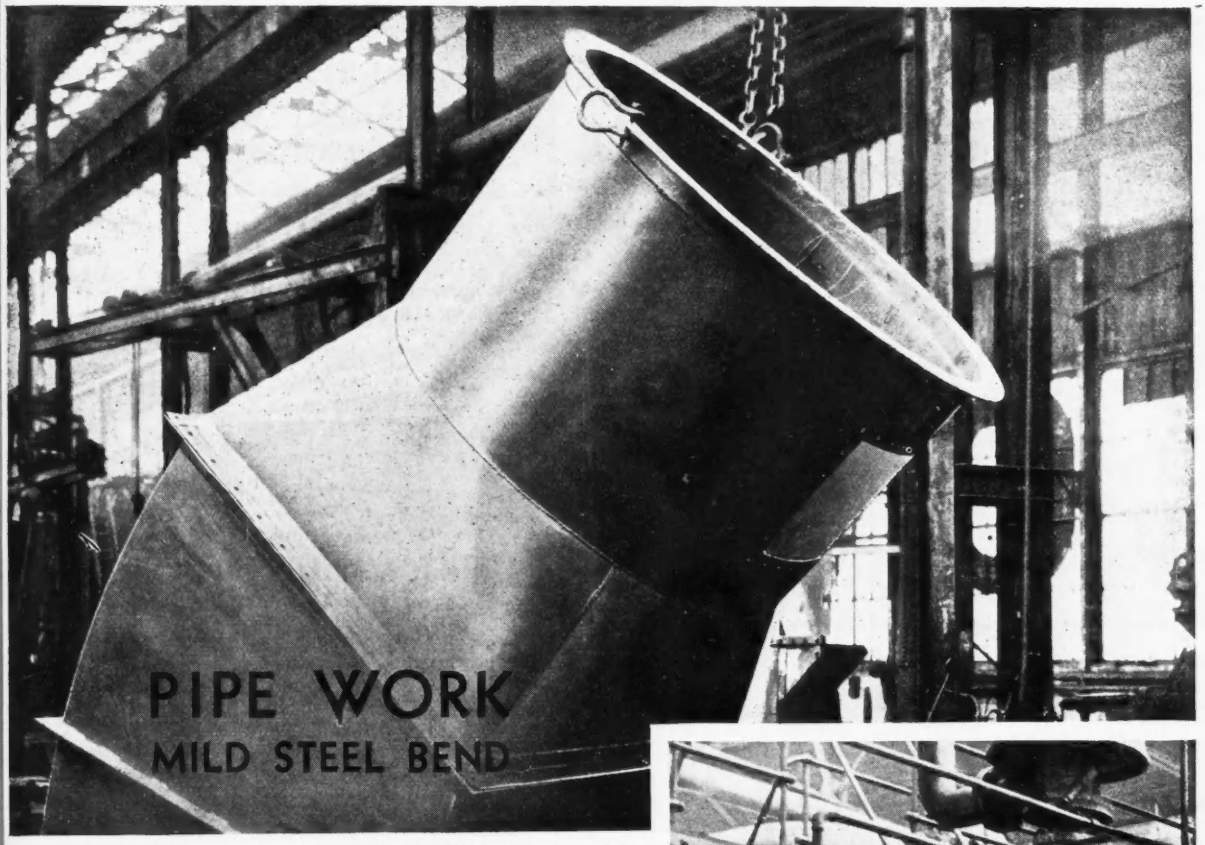

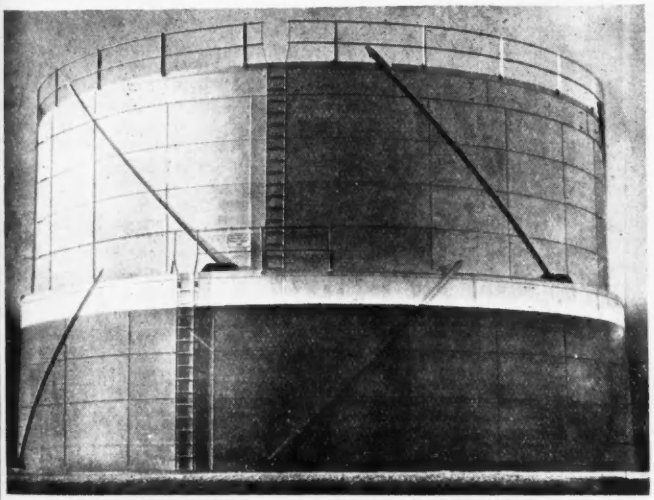

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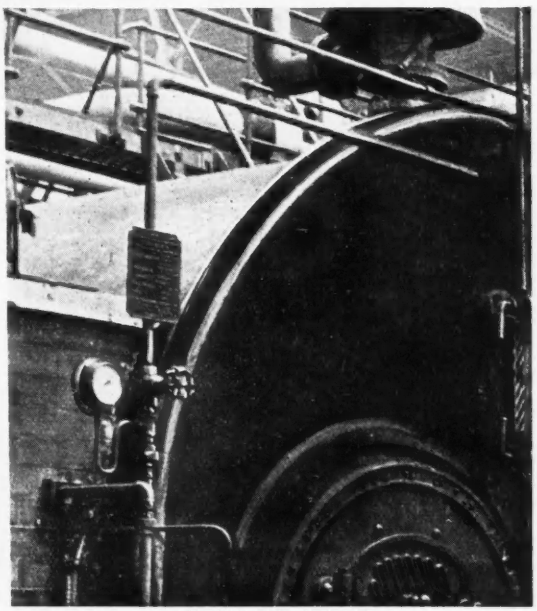

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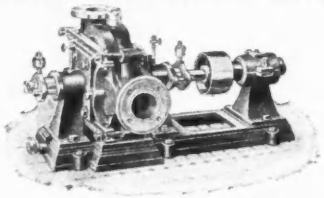

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Inventions in the Chemical Industry

The following information is prepared from the Official Patents Journal. Printed copies of Specifications accepted may be obtained from the Patent Office, 25 Southampton Buildings, London, W.C.2, at 1s. each. The numbers given under "Applications for Patents" are for reference in all correspondence up to the acceptance of the Complete Specification.

Applications for Patents

Manufacture of water-soluble vegetable colloid pastes, etc.—African Sisal and Produce Co., Ltd., and A. A. Newman. 10300.

Preparation of aqueous dispersions of synthetic resins.—American Cyanamid Co. (United States, Dec. 13, '40.) 10038.

Sulphonated esters of cisendomethylene-3, 6-Δ4-tetrahydrophthalic acid.—American Cyanamid Co. (United States, Dec. 24, '40.) 10124.

Testing of synthetic resin-coated bands, etc.—M. J. Cradick and Metropolitan-Vickers Electrical Co., Ltd. 10194.

Splitting-off of hydrogen halide from halogenated hydrocarbons.—Distillers Co., Ltd., M. Mugdan and D. H. R. Barton. 10123.

Treatment of polymeric materials.—E. I. du Pont de Nemours and Co., and E. K. Bolton. 10284.

Manufacture of polyazo dyestuffs.—J. R. Geigy A.-G. (Switzerland, Aug. 10, '40.) 10161.

Manufacture of hydrochloric acid.—W. W. Gleave and Imperial Chemical Industries, Ltd. 10087.

Hydrocarbon conversion.—International Catalytic Oil Processes Corporation. (United States, Sept. 28, '40.) 10205.

Manufacture of dihydroxy halogenated diphenyl methanes.—L. Mellersh-Jackson (B. T. Bush, Inc.). 10052.

Manufacture of comminuted soaps.—Lever Bros. and Unilever, Ltd. (United States, Aug. 15, '40.) 10233.

Manufacture of detergents.—Lever Bros. and Unilever, Ltd. (United States, Aug. 14, '40.) 10234.

Production of thermoplastic substance in sheet form.—C. F. Lumb. 10203.

Manufacture of arylacetonitrile derivatives, etc.—Roche Products, Ltd., F. Bergel, N. C. Hindley, A. L. Morrison, and H. Rinderknecht. 10249.

Manufacture of benzene-sulphonimino derivatives.—Soc. of Chemical Industry in Basle. (Switzerland, Nov. 22, '40.) 10230. (Switzerland, April 16.) (Cognate with 10230). 10231.

Manufacture of fluorene derivatives.—A. R. Todd, G. Swain and Imperial Chemical Industries, Ltd. 10237.

Manufacture of organic compounds.—J. Wright. 10287.

Complete Specifications Open to Public Inspection

Method of producing cast iron, and compositions therefor.—Electro Metallurgical Co. Feb. 6, 1940. (Cognate application 17265/40.) 17264/40.

Manufacture of lubricants.—Standard Oil Development Co. Dec. 27, 1939. (Cognate application 18154/40.) 18153/40.

Process for the production of low-temperature carbonisation smokeless shaped briquettes of high batch weight.—F. Duscher Cerri. Feb. 6, 1940. 1146/41.

Preparation of tetraacetylated n-aryl ribityl amines.—C. Pfizer and Co. Feb. 7, 1940. 1347/41.

Process for the manufacture of organo-silicon polymers, and product produced thereby.—Corning Glass Works. Feb. 10, 1940. (Cognate application, 1783/41.) 1782/41.

Method of increasing the wet strength of paper.—American Cyanamid Co. Feb. 6, 1940. 1864/41.

Complete Specifications Accepted

Manufacture of dyestuffs of the anthraquinone series.—Imperial Chemical Industries, Ltd. (E. I. du Pont de Nemours and Co.). Jan. 30, 1940. 538,377, 538,378.

Manufacture of hydrogen.—Power-Gas Corporation, Ltd., R. W. Rutherford and A. T. Grisenthwaite. Feb. 5, 1940. 538,348.

Catalytic cracking of hydrocarbon oils.—C. Arnold (Standard-I.G. Co.). Feb. 6, 1940. 538,414.

Production of ammonia solutions.—Wallace and Tiernan, Ltd., and V. A. Wilmslow. March 29, 1940. 538,392.

Manufacture of sodium citrate pentahydrate.—California Fruit Growers Exchange. April 10, 1939. 538,350.

Mechanism for screening solid materials.—F. Parker, Ltd., and F. W. Parker. Jan. 27, 1941. 538,337.

Metallurgical Section

October 4, 1941

TIN-LEAD SOLDERS

A Study of their Spectrographic Analysis*

AN investigation of the spectrographic analysis of tin-lead solders, by D. M. Smith, B.Sc., D.I.C., F. Inst.P., has been carried out by the British Non-Ferrous Metals Research Association with the aid of funds provided by the International Tin Research and Development Council. It deals with the quantitative determination of small amounts, of the order of 0.1 per cent. and less, of aluminium, bismuth, cadmium, copper, and zinc in tin-lead solders. Graded series of alloys of solder with aluminium, cadmium, and zinc were kindly supplied by Mr. J. Cartland, of Messrs. Fry's Metal Foundries, Ltd., London. Alloys with bismuth were prepared in the Association's laboratory. In view of the difficulty in obtaining satisfactory chemical checks on the composition of these alloys, synthetic residues have been prepared by mixing solutions of the various constituents in the appropriate proportions and evaporating to dryness. Residues of alloys, obtained by dissolving and evaporating, have been compared with the synthetic residues by means of the graphite arc. The method was found to be useful in obtaining a series of standard alloys that can be used with confidence, but is too tedious for use in routine analysis.

Analytical tables based on the "internal standard" method have therefore been compiled from spark spectra obtained by the use of metallic electrodes following the usual procedure. It has been observed that the solder spectrum resembles the tin spectrum in many respects, but shows marked differences as compared with the lead spectrum. Conditions of spark excitation standardised for the analysis of tin have therefore been adopted.

Preparation of Standards

Attempts were first made to prepare solder standards by melting in evacuated Pyrex tubes accurately weighed quantities of the constituent metals, but these proved unsuccessful. R. G. Ernst, of the United States Metals Refining Co., New Jersey, however, reports, in a private communication, the successful preparation of synthetic standards for the determination of zinc and bismuth in solders, by melting the constituents together in a glass tube under hydrogen. Whether this technique would give reliable standards for aluminium does not appear to have been investigated, this element giving the most difficulty as regards uniform distribution in the solidified alloy.

A series of synthetic residues was prepared as ultimate standards of reference. The constituent metals were dissolved in appropriate acids and accurately measured quantities of the solutions were added together and taken to dryness with hydrochloric acid. By suitable dilutions of the solutions of the impurity metals, it was possible to produce a graded series of synthetic mixtures of accurately known composition. The residues were thoroughly ground and mixed before making the spectrographic tests. Since these residues are somewhat hygroscopic, precautions were taken to preserve them in a dry atmosphere until the completion of the tests. Two series were prepared; in the first, the principal constituents were tin and lead in equal proportions, while in the second series, representing antimonial solders, the principal constituents were 50 per cent. tin, 47.2 per cent. lead and 2.8 per cent. antimony. In each series, aluminium, bismuth, cadmium and zinc were added in the following proportions: 0.1, 0.05, 0.025, 0.01, 0.005 and 0.001 per cent. respectively. A further sample was prepared from the pure tin and lead with no admixtures. Spectrographic analyses of the lead and tin were made with the results shown in Table I. The other metals used were of the highest purity available.

TABLE I

Analysis of the Tin and Lead used in the Preparation of the Synthetic Residues.

	Lead	Tin
Aluminium	not detected	not detected
Bismuth	0.0004%	0.002%
Cadmium	Less than 0.0001%	not detected
Copper	0.001%	0.003%
Zinc	not detected	not detected

Table II gives the composition of the metallic alloys used in this work.

TABLE II

Composition of the Standard Alloys.

Element Studied	Percentage Range	%Sn	%Pb	%Sb
Aluminium	0.001 —0.05	50.0	47.2	2.8
Bismuth	0.0012—0.1	45.0	52.5	2.5
	0.0013—0.1	50.0	50.0	—
Cadmium	0.001 —0.05	50.0	47.2	2.8
Zinc	0.001 —0.05	50.0	47.2	2.8

Preliminary tests indicated that when using a 5-amp. graphite arc for the analysis of solder residues, greater regularity in the spectra resulted from making the sample the positive electrode. Increasing the size of the sample led to an increase in the blackening of the lines and continuous background in the spectrum. Approximately equal quantities of the residues, sufficient to fill a shallow cavity in the lower electrode, were used in each case, so that the conditions were maintained constant for synthetic residues and residues from alloys alike. The spectra were photographed with the medium size spectrograph (0.007 mm. slit width) using Ilford Special Lantern plates and giving an exposure of 1 min. (timed from the moment of striking the arc). To obviate any possible disturbing effects due to the presence of antimony, comparison was made between residues of similar composition.

Irregularities with Aluminium Impurities

For all the impurities studied except aluminium the residues gave spectra showing a systematic increase in the intensities of the impurity lines with increasing percentage content, thus enabling the contents of the alloys to be used as metallic standards to be ascertained by direct comparison of the spectra. Within the limits of visual observation, the compositions aimed at in preparing the alloys were confirmed and, from the data thus obtained, analytical tables were compiled. Irregularities were observed, however, in the case of the samples containing aluminium. Variations in intensity of the aluminium lines were obtained in duplicate spectra and satisfactory correlation was not shown between intensity and percentage content. This, as might be expected, is probably due to the volatility of aluminium chloride and possibly, in some measure, to formation of non-conducting alumina. It appears desirable therefore, to make a more detailed study of graphite arc methods for the analysis of such samples, from the point of view of reproducibility of the relative intensities of lines in the spectra. Tables of the sensitive lines and

* Abridged from Publication No. 105 of the Tin Research Institute.

analytical tables, using tin lines as internal standards, are given in full in the original publication.

In general the apparatus and technique used for the spectrographic analysis of tin has been adopted for the analysis of solders. The conditions of excitation and photography of the spark spectra are summarised below :—

Capacity : 0.006 μF.
Self-inductance : 0.03 mH.
Spark length : ⅛ in. (3 mm.).
Distance of Spark from (medium-size) spectrograph slit : 20 cm. (No condensing lens used).
Spectrograph slit width : 0.02 mm.
Time of Exposure : 90 secs., after a pre-sparking period of 20 secs.
Development : should be continued until the group of tin lines in the region of 2100 Å is clearly visible on the developed plate.
Form of electrodes : Small rods, approximately 1.5 cm. long and 5 × 5 mm. cross-section, roughly pointed to an angle of about 70°.

The spark between solder electrodes is considerably steadier as regards the intensity of light emitted than that between tin electrodes. The low value of inductance used is also an advantage from this point of view, since with higher inductance the tendency for the electrodes to melt becomes more pronounced. It appears desirable with small samples to give several short exposures, totalling 90 sec., rather than to run the spark continuously for the whole period. With modern types of spectrograph, however, shorter times of exposure can be used.

While in general appearance the solder spectrum more closely resembles that of tin than that of lead, a detailed comparison of the three types of spectra reveals a number of differences with respect to the relative intensities of the lines. These phenomena are described below as they may have an important bearing on the general problem of the effect of alloying constituents on the spectrum of the basis metal. The solder spectrum consists of the lead spectrum superposed on the tin spectrum and, in the case of antimonial solders, with the addition of the stronger lines of the antimony spectrum. Under the same conditions of excitation and photography, the solder spark spectra as compared with the spectra of tin and lead show the following features :

1. In general the lines of the tin spectrum appear slightly weaker in the solder spectra, whereas the lead lines are somewhat enhanced.

2. Individual lines, particularly the faint lines (such as are used for internal standards) and spark lines, for example, show marked differences in intensity.

3. In the case of the determination of bismuth, the presence of 2.5 to 2.8 per cent. antimony appears to have no effect on the relative intensities of bismuth and internal standard tin lines in the spectra of the antimony-free and antimonial solders. In other words, direct comparison may be made between antimony-free and antimonial solders so far as the determination of bismuth is concerned. Whether this also holds for the other impurities is a matter for further investigation.

The tin and lead contents of the antimonial solders differ from those of the non-antimonial solders, but these differences are such that they are not detected by ordinary visual comparison of spectra.

Conclusions

1. In view of the similarity between the spark spectra of tin and tin-lead solder, the standardised conditions of excitation and photography previously used for the analysis of tin have been adopted for the determination of impurities in solder.

2. Analytical tables have been compiled for the quantitative determination of small amounts, of the order of 0.1 per cent. to 0.001 per cent. of bismuth, cadmium, copper, and zinc. Suitable sensitive lines for the determination of aluminium are put forward.

3. Synthetic standards, including all the major impurities except copper, have been prepared in the form of residues evaporated from solutions of the constituent metals. Alloys prepared with varying quantities of impurities were also dissolved in acid and the solutions evaporated. The residues obtained were compared with the synthetic standard residues, using a graphite arc method. It was not considered necessary to adopt this procedure with respect to copper contents since chemical analysis proved satisfactory for this element.

4. The residue method of analysis is useful to check the composition of alloys to be used as standards, but is not recommended for routine analyses on account of the time and manipulation involved and the standardised spark method is preferred.

Suggestions for Further Work

In view of the irregularities observed in the intensities of aluminium lines in the spectra of residues of solder containing small quantities of this element, a more detailed study of graphite arc methods for the analysis of such samples appears desirable. The following simple modifications of the method described in the present report are therefore put forward as profitable directions for further investigation.

1. *Complete Volatilisation of the Residue.* Preliminary tests with systematically increased times of exposure would be required in order to establish the time necessary for complete volatilisation of all the constituents. Some reduction in the size of the sample under test would probably be required, in order to keep the exposure time within reasonable limits and the use of weighed samples would be considered in this connection.

2. *Methods for Regulating the Consumption of the Material in the Arc.* (i) *The sulphate Method of S. Judd Lewis.*[1] In this method, which appears to be applicable to both organic and inorganic materials, all the metals present are reduced to sulphates by treatment with sulphuric acid. The dry residue is then mixed with an equal quantity of spectroscopically pure ammonium sulphate and pressed into a pellet. It is claimed that "the sulphation assisted by the ammonium sulphate helps greatly to regulate the arcing effect and to ensure much more constant results." (ii) *The Nitrate Method of E. K. Jaycox and A. E. Ruehle.*[2] Mixing the sample with purified carbon dust, adding 0.05 ml. of 10 per cent. nitric acid, followed by drying the mixture in a cavity in the supporting graphite electrode, on a hot plate, is recommended for the analysis of aluminium and its alloys in the form of powdered nitrates. Also, the use of a collodion-coated electrode, as used in the direct analysis of solutions, to prevent absorption by the graphite during the evaporation process, might prove advantageous for the analysis of solder residues by this nitrate method.

(1) *Spectroscopy in Science and Industry*, Blackie & Son, Ltd. 1933, p. 42.
(2) *Quantitative Spectrochemical Analysis of Alloys, Solutions and Powders. (Proc. 7th Summer Conference on Spectroscopy and its Applications.* The Technology Press, 1940, pp. 10-15.

Electrolytic Tinplate

Commercial Production in Strip Form

AFTER three years of experiment, the United Engineering and Foundry Company, of New York, announced last week that it had solved the problem of producing electrolytic tinplate in strip form in commercial quantities. One of the most important results of the new method, it is stated, is the saving of two-thirds of the tin now used in the hot-dip method, involving a reduction in cost for tin alone approaching $10 a ton. The company's development engineer further stated that conversion costs of electro-tinning can actually be lower than hot-dipping. This occurs at production speeds in excess of 200 to 300 feet a minute, since labour and installation costs, etc., remain constant. Production will be between 5000 and 10,000 tons a month.

Surface Treatment in a Steel Furnace

Observations with a Pyrometer

IN the production of some special steels cast iron is treated with oxygen supplied from above, as distinct from "blast boxes" at the bottom of a Bessemer converter. K. J. Markevich measured the surface temperatures obtaining in this process (*see Zapiski* of the Chem. Inst. Ukrain. Acad. Sci., 1940, *7*, 105).

Gray cast iron was contained in a chamotte crucible, some 70 cm. high and 40 cm. wide. The crucible had a conical lid through which passed a vertical tube made of quartz and lined outside with graphite. Through the tube oxygen was supplied, and in the top part was fixed an optical pyrometer which gave the temperature of the metal on its surface within the tube.

The temperature observed depended on the depth of the immersion of the tube into the metal. Keeping other conditions constant, when the depth was 12 cm. the surface temperature was 1670° C.; at 20 cm. it was 1830° C. When the depth was constant the surface temperature was determined by the balance between the heat supplied by the oxidation process and the heat carried away by hot gases and spread over the bulk of metal. This last-named amount depends on the stirring of the molten iron by the oxygen blast, *i.e.*, on the speed of blow. The heat of oxidation depends evidently on the amount of oxygen supplied per second. The speed of blow and the amount supplied could be varied independently by varying the bore of the tube through which oxygen was introduced.

Some results of Markevich's experiments are reproduced here. When the bulk temperature of cast iron was 1030° C., and the supply of oxygen 3.3 litres per sec., the surface temperature was 1430° C., when the speed of oxygen was 15.6 cm. per sec. and 1130° C., when it was 4.2 cm. per sec. or 1.9 cm. per sec. When the constant rate of supply was 7.5 litres per sec., the surface temperature was 1590° C. for the speed of 38.2 cm. per sec., 1430° C. for 9.7 cm. per sec., and 1330° C. for 4.3 cm. per sec. The decrease of the temperature on a decrease of speed was due to the fact that impurities in iron were oxidised more rapidly when its surface was stirred by the gas; this effect was more important than the increase of convection due to this stirring. When the pressure of oxygen was kept constant the effect of the speed was scarcely noticeable. When the excess of pressure over the atmospheric was 0.5 atm. the surface temperature was 1230-1280° C.; when it was 3 atm. the surface temperature rose to 1590-1690° C.

When the bulk temperature of iron was kept at 1130° C., the surface temperatures were much higher. For 3.3 litres per sec. for the speeds 15.6, 4.2, and 1.9 cm. per sec. the temperatures 1550°, 1480°, and 1430° C. were observed. For 10 litres per sec. the temperatures 1700° and 1690° C. were found for the speeds of 12.7 and 5.7 cm. per sec.

The Rolling of a Magnesium Alloy

Tests on Elektron AM 503

AN investigation on the rolling of a magnesium alloy, carried out by Professor W. R. D. Jones, D.Sc., M.Inst.M., and L. Powell, B.Sc. (both of the Dept. of Metallurgy and Fuel Technology, University College, Cardiff) is recorded in *J. Inst. Met.*, 1941, *67*, 899, pp. 153-172. It was carried out on lines similar to the authors' previous work on the rolling of magnesium metal, and the alloy used was Elektron AM503, recognised as a generally serviceable material, in slabs cast by Magnesium Elektron, Ltd., of Manchester. The analysis of the material in the ladle was: manganese 2.28, aluminium 0.05, silicon 0.02, copper 0.01 per cent., zinc, a trace. The rolling operations were carried out on a Robertson 3-high, 24 in., non-reversible mill, using a speed of 60 ft. per minute. The rolls, highly polished, were preheated to about 90° C. for hot rolling.

Ten-gauge sheets were produced by rolling (1) cast slabs of a magnesium alloy, and (2) slabs extruded from a chill cast circular ingot teemed from the same ladle of molten alloy as that from which the cast slabs were produced. These sheets were then reduced to 16 gauge (*i.e.*, a 100 per cent. extension) by a combination of hot- and cold-rolling, so that the finished sheets had received 0, 5, 10, 25, 50, 75, and 100 per cent. cold extension. The sheets were annealed at 0°, 100°, 200°, 300°, 400°, and 500° C. Tensile test pieces were prepared transverse, longitudinal, and at 45° to the direction of rolling. The tensile tests were carried out on an Olsen hand-operated 10,000 lb. machine. Hardness tests and grain-size counts were also carried out on the sheets.

The results of the tests for sheets produced from cast slabs and from extruded slabs are similar. The mechanical properties in the direction at right angles to that of rolling were higher than those in other directions, and the differences between longitudinal and transverse test-pieces became more pronounced the greater the amount of cold work. Cold rolling and annealing produced no important improvement in the properties of hot-rolled sheets. The tenacity figures were not seriously affected by cold work up to 50 per cent. extension, but the ductility figures were decreased. After annealing, the hardness of the sheets reached a constant value related to the annealing temperature and not to the amount of cold work. When the amount of cold work was not greater than that equivalent to 50 per cent. extension, annealing at temperaures up to 300° C. had little influence. The effects of small amounts of cold work, which were very noticeable in the case of unalloyed magnesium, were not serious in this alloy, and there did not seem to be any critical combination of cold work and annealing temperature which would give rise to excessive grain growth accompanied by decreased mechanical properties. The general conclusion was reached that cold rolling up to 50 per cent. extension was not harmful and that annealing at 300° C., although not really necessary, caused slight improvement. Cold rolling produced marked directional properties which were not eradicated by annealing even at temperatures up to 500° C.

Sheets can be produced by rolling direct from cast slabs, and these have mechanical properties at least equal, if not superior, to those produced from extruded slabs.

Reduction of Iron Ore

The Effect of Water Vapour

FROM experiments by Bone and others it is known that water vapour lowers the rate of reduction of iron ores by carbon monoxide. E. P. Tativevskava (*J. Phys. Chem. Russ.*, 1940, *14*, 349) points out that this lowering is not due to water itself, but to carbon dioxide to which the water has given rise. In the presence of a quantity of carbon monoxide the equilibrium of the water gas $CO+H_2O \rightleftharpoons CO_2+H_2$ is shifted to the right, *i.e.*, water added to the carbon monoxide is to a large extent transformed into CO_2 and H_2. For instance, at 500° C. a mixture of 90 per cent. CO and 10 per cent. H_2O becomes one of CO 80.25, H_2O 0.25, CO_2 9.75, and H_2 9.75 per cent. Therefore, the direct effect of water, if it exists at all, is masked by that of carbon monoxide.

Tativevskaya allowed mixtures of CO and H_2O to circulate over magnetite (containing 99.2 per cent. Fe_3O_4) or hæmatite (containing 98.6 per cent. Fe_2O_3) at 500° or 900° C. The rate of reduction was strongly decreased by amounts of water as small as 2.5 per cent. This decrease could be compared with the similar effect produced by carbon dioxide in a concentration equal to that attained as result of the water gas equilibrium; and both effects appeared to have identical magnitudes.

Pure hæmatite is reduced by CO in presence of CO_2 as rapidly as in its absence. Water vapour also did not affect the rate of reduction of Fe_2O_3 by CO. Hæmatite partly reduced by CO becomes sensitive to the presence of CO_2: in agreement with Tatiyevskaya's theory its reduction is retarded by water vapour as well. Partly reduced magnetite is only very slowly reduced by carbon monoxide containing either carbon dioxide or water vapour.

New Bearing Alloy

Tests of Tin-Rich Alloy in Sea Water

SINCE up to the present no completely satisfactory material has been found for the construction of the tail-shaft bearings of large ocean-going vessels, an investigation directed towards finding a suitable alloy has been conducted by Dr. E. S. Hedges, D.Sc., Ph.D., A.I.C., Research Manager, Tin Research Institute, and is reported in Tin and its Uses (1941, *10*, pp. 5, 6).

The bearings in question are immersed in a rapidly moving stream of aërated sea-water, and as they are in contact with a large mass of steel similarly exposed, the tendency to corrosion is accelerated by galvanic effects. In addition, lubrication during a voyage presents difficulties, yet the functioning of the bearing is absolutely vital to the safety of the ship and the bearing must neither seize nor give rise to rapid wear. Lignum vitæ has been widely used, in spite of such structural complications as the necessity for using bronze shells for the lignum vitæ strips and for bronze bushes on the steel propeller shafts. White metal alloys are more easily fitted from the mechanical point of view, and although subject to electrolytic corrosion their anti-friction qualities are outstanding. One alloy of this type containing tin, zinc, and copper is widely used on important types of ships and it was taken as the basis of comparison throughout the investigations.

The objective set was to find an alloy which, under working conditions, had the same electro-potential as mild steel and which had anti-friction qualities at least as good as those of the representative alloy which is referred to hereunder as alloy "X."

Initial and Final Tests

A group of tin-rich alloys was chosen for examination, as the constitution and properties of these alloys were already understood as a result of previous work in the Institute's laboratories. Initial tests were made on the corrosion (alone and in contact with mild steel) of the alloys in salt solution, and on the difference of electro-potential between these alloys and steel. The more suitable alloys were then tested for anti-friction properties, both when running in oil and in sea-water; and finally the behaviour of different alloys as bearings was compared in an apparatus in which a shaft rotated in the bearings in highly aërated sea-water, under simulated service conditions.

In the electrochemical tests one alloy was found to be equipotential with mild steel in aërated sea-water. This alloy also proved to have superior anti-friction properties, especially when running in sea-water without oil lubrication. The behaviour of the new alloy is compared in Table I with that of alloy X and with that of a high-tin babbitt (composition: tin 89.5, antimony 7, copper 3.5 per cent.). It should be noted that, while the anti-friction properties of the high-tin babbitt are good, in these experiments the babbitt was found to corrode in salt solution with the formation of "black spots," and the results were less

TABLE I

Composition	e.m.f. against mild steel	Change in weight (mg.) 5 days at room temperature	5 days at 25° C. with aeration	21 days at 25° C.	21 days at 25° C. in contact with steel
Alloy X ..	−0.34	−14.3	−36.6	−187.0	−857.3
High-tin babbitt ..	+0.25	not measured	− 3.2	−89.0	−12.1
New alloy ..	+0.01	+13.8	− 3.5	−13.4	−42.9

Electrochemical behaviour and corrosion in 3 per cent. sodium chloride solution

favourable than would appear from the figures in the last column. As a preliminary test, the running times required for seizure of some of the bearings in the experimental friction machine, without oil lubrication, were determined, using a constant load of 6200 lb. per sq. in. and a rubbing speed of 1200 ft. per minute, and were found to be: for alloy X 3 minutes; for the new alloy 5 minutes.

The alloys under test were lined inside steel shells, located at intervals along a steel shaft rotated by an electric motor to give a rubbing speed of 750 ft. per minute. The shaft and bearings were enclosed in a teak tank. The tank was filled with sea-water, which was vigorously agitated and aërated by a bronze stirrer rotating with the steel shaft. The bearings were held against the shaft by loading with weights so as to give a bearing pressure of 70 lb. sq. in. The time for seizure of the alloys under these conditions was determined with and without oil lubrication, as under:—

TABLE II

Alloy	With Oil	Without Oil
Alloy X	14.5 hr.	4 hr.
High-tin babbitt ..	>122 ,,	>62 ,,
New Alloy	>122 ,,	>62 ,,

Time of seizure in aerated sea-water

The new alloy is almost equipotential with steel; it has a high intrinsic resistance to corrosion by sea-water, has a favourable anti-friction curve, and does not seize as a bearing under the testing conditions even in absence of lubricant. The alloy is easily made at 350° C. and is cast at about 300° C.; it has a high degree of adhesion to steel (bond strength 11.4 tons per sq. in. in tension and 5.1 tons per sq. in. in shear, as compared with 8.6 and 5.1 tons per sq. in. for the high-tin babbitt); the Brinell hardness is 35.7 and the tensile strength 7.4 tons per sq. in.

High Tensile Steel for Welding

War Emergency Specification

ALL high tensile structural steel has been covered largely by the requirements of B.S. 548, High Tensile Structural Steel for Bridges, etc., but the British Standards Institution has now issued B.S. 968-1941 which provides for a special quality for welding purposes.

Recent investigations made by the Institute of Welding have shown that, unless special precautions are taken when welding high tensile steel, difficulties may arise due to hardening at the weld boundaries. With a given set of welding factors the degree of this hardening may be reduced by lowering the carbon content of the steels, and as a result, special welding quality high tensile steels are now available with maximum carbon contents considerably lower than the 0.30 per cent. which is allowed by B.S. 548, and with corresponding improved weldability.

This British Standard relates to steels of this type in which the carbon content is limited to a maximum of 0.25 per cent. and which are designated "high tensile (fusion welding quality) steels," abbreviated to H.T.W. steels. The material covered by this specification is suitable for fusion welding but is not suitable for forge or smith welding. Copies of this specification may be obtained from the British Standards Institution, 28 Victoria Street, London, S.W.1, price 2s. 3d., post free.

Illustrated leaflets recently issued by RUBERY OWEN MESSIER, LTD., Liverpool Road, Warrington, Lancs., graphically substantiate their claim to be able to "weld practically anything" (electric or oxy-acetylene). They specialise in welded fabrication, including chemical plant and machinery, pipework, and both riveted and welded vessels. Galvanising also is a speciality, and a photograph shows their galvanising ship in action.

General News

The Committee of the Mining and Metallurgical Club reports that the club's premises at 3 London Wall Buildings, E.C.2, will be partially reopened on October 1.

The Ministry of Agriculture announces that arrangements have been made for reasonable supplies of potash and soft soap to be made available to manufacturers of sprays for horticultural purposes. This applies to essential cases only.

The Ministry of Food announces that there will be no change in the existing prices of oils and fats allocated to primary wholesalers and large trade users for the five weeks ending November 1.

The Institute of Chemistry has reprinted in pamphlet form the lectures by Dr. A. H. Cook on Chromatographic Analysis and by Mr. E. J. Vaughan on the Use of the Spekker Photo-Electric Absorptiometer in Metallurgical Analysis.

Advanced technical courses in chemical engineering are being given at Huddersfield Technical College (Thursdays, 7.30-9 p.m.) and Leeds College of Technology (Fridays, 7-8.30 p.m.). The lecturers are: at Leeds, Mr. A. Briggs, A.M.I.Chem.E., at Huddersfield, Mr. C. H. Bowden, A.M.I.Chem.E.

According to the Statistical Bulletin of the Tin Research Institute, world production of tin in August, 1941, is estimated at 21,300 long tons, compared with 18,400 tons in August, 1940. Production for the first eight months was 168,600 tons in 1941 against 143,500 tons in 1940.

In compiling a register of plants at present in use or idle, which may be suitable for vegetable drying either immediately or after adaptation, the Ministry of Food is seeking information regarding tray driers (cabinet and tunnel conveyor driers and rotary driers). The owners of such drying plants are asked to write to the Ministry of Food, Dehydration Branch, Bay View Road, Colwyn Bay, N. Wales, giving the address of each separate plant.

Communal meals for children are an essential step towards better nutrition, according to Professor R. A. Peters, Whitley Professor of Biochemistry at Oxford. Professor Peters points out, with much justice, the impossibility of imparting a knowledge of nutritional science to all the busy mothers in this country; whereas if every child could have at least one communeral meal a day, the preparation of the food could be carried out with due regard to essential dietetic details.

Foreign News

Pyrethum shipped from Kenya during May amounted to 660 tons, of which 640 went to the United States.

From Mexico it is reported that the U.S. Government has bought Mexican mercury at a price of $170 a flask, duty excluded.

Production of recoverable lead in the United States for the first quarter of 1941 was 112,992 tons; for April, 38,234 tons; and for May, 39,116 tons. During the whole of 1940, the production totalled 457,392 short tons.

A cinnabar deposit is being developed in the Bubi district of Southern Rhodesia with Government assistance. At the end of 1940 its prospects were considered to be sufficiently encouraging to warrant further assistance being granted.

The Department of Supply of the Government of India has cancelled the notification of May 26 prohibiting the use of certain chemical substances except in connection with current war orders.

Copper, chromite, cobalt, lead and asbestos deposits in Northern Australia are surveyed in the most recently published reports of the Aërial, Geological and Geophysical Survey of Northern Australia.

Production of chrome ore in the Union of South Africa amounted to 180,390 short tons in 1940, compared with 176,386 in 1939, and 37,671 in the first quarter of 1941. Exports of the ore were 183,279 tons in 1939, 118,673 in 1940, and 21,605 in the first quarter of 1941.

From Week to Week

Rumours of industrial expansion in Colombia are quoted by *Foreign Commerce Weekly*. These include the report of extensions to the sulphuric acid and copper sulphate plant at Medellin, and the opening of native copper mines to make up for the shortage of copper imports from the U.S.A.

According to a Vichy radio report an explosion, which took place last week, caused great damage to a Bordeaux alcohol factory producing synthetic petrol. All the tanks in the plant are said to have exploded and part of the factory buildings collapsed.

The Board of Scientific and Industrial Research of India has decided to establish two permanent museums, one at Delhi and the other at Calcutta, which will house samples of products already obtained as a result of researches conducted under the auspices of the Board.

Rayon and staple-fibre manufacturers in Japan are said to be facing a serious shortage of caustic soda. This situation is particularly unfortunate at a time when increased production of chemical fibres is of importance owing to difficulties in obtaining cotton and wool from overseas.

The Government of India has approved the erection of a State-owned plant for the production of super-tropical and tropical bleaching powder. The Department of Supply has arranged for the manufacture of B.P. zinc oxide, and plans are stated to be already well advanced for the manufacture of citric acid and citrates.

Domestic production of manganese ore in the United States, containing 35 per cent. or more manganese (natural) during June was 3100 long tons, shipments were 3300 tons, and producers' stocks at the end of the month were 1300 tons, according to the Bureau of Mines. In May, production was 2600 tons, shipments 2900 tons, and producers' stocks 1500 tons.

Forthcoming Events

The course of 12 Saturday lectures entitled "Recent Advances in Paint and Varnish Technology," which is being given at the College of Technology, Manchester, by the Manchester section of the **Oil and Colour Chemists' Association**, will continue throughout the **Saturdays in October** (starting at 2.30 p.m.). The lectures deal with drying oils, synthetic resins, pigments, and general paint technology, and are delivered by Messrs. C. W. A. Mundy, A.I.C., F. J. Siddle, Ph.D., G. A Campbell, M.Sc., and E. J. Bond, B.Sc., F.I.C.

A meeting of the **Institute of Fuel** will be held in the Connaught Rooms, Great Queen Street, W.C.2, on **October 15**, at 2.30 p.m., when Lieut.-Col. Sir John Greenly, K.C.M.G., C.B.E., F.Inst.F., will instal Mr. W. M. Selvey, Wh.Sc., A.R.C.S., M.Inst.C.F., M.I.Mech.E., M.I.E.E., F.Inst.F., as President of the Institute for the coming year. After the installation, Mr. Selvey will give his presidential address entitled, "The Hundred Thousand: An Engineer's Philosophy." During the meeting the Melchett Medal for 1941 will be presented to Dr. Clarence A. Seyler, D.Sc., F.I.C., F.Inst.F., who will present the Melchett Lecture, entitled, "Recent Progress in Coal Petrology."

The East London Branch of the **Association of Scientific Workers** will hold a meeting on **October 19**, at the West Ham Municipal College, commencing at 2.30 p.m., when Dr. Fudge, of the Science Department of the College, is to give a talk on the training of the chemical assistant. All scientific workers are invited to attend.

The fourth Hinchley Memorial Lecture is to be delivered before the **Institution of Chemical Engineers** by Sir Richard A. Gregory, Bart., D.Sc., LL.D., F.Inst.P., F.R.S., on "Scientific Knowledge and Action." The lecture will be delivered in the Reading Room of the Institution of Civil Engineers, Great George Street, London, S.W.1, on **October 24**, at 2.30 p.m., the President, Mr. C. S. Garland, presiding. Non-members will be welcome and tickets may be obtained for them on application to the assistant secretary.

Commercial Intelligence

The following are taken from printed reports, but we cannot be responsible for errors that may occur.

Receivership

B. P. S., LTD. (R., 4/10/41.) D. Gubbay, of First Avenue House, High Holborn, W.C.1, was appointed receiver and manager on September 10, under powers contained in debentures dated February 29 and May 10, 1940.

Receiver Ceasing to Act

NURO (BIGGLESWADE), LTD. (R.C.A., 4/10/41.) F. E. Board, of 22 High Street, Sheffield, ceased to act as receiver and manager on September 15.

Company Winding-Up Voluntarily

TRIPHASE FURNACE CO., LTD. (C.W.U.V., 4/10/41.) September 19. Reginald Montgomery, F.L.A.A., Imperial Buildings, Rotherham, appointed liquidator.

Satisfaction

DAVEY, PAXMAN AND CO. (COLCHESTER), LTD. (M.S., 4/10/41.) Satisfaction, September 8, of debenture stock registered June 7, 1938, to the extent of £500.

Company News

Parsons, Fletcher and Co., Ltd. Printing ink manufacturers, etc., 17 Great Suffolk Street, London, S.E.1, changed their name to P. F. Trust, Ltd., on September 13.

International Diatomite, Ltd., record a loss of £779 for the year ended March 31 (last year, £6791 profit). No dividend is declared, as against 4 per cent. last year.

The United Premier Oil and Cake Co., Ltd., have declared an interim dividend of 6⅔ per cent. on the 5s. ordinary shares, payable November 1. The same interim in 1940 was followed by a 6⅔ per cent. final payment.

Chemical and Allied Stocks and Shares

INACTIVE conditions prevailed in the stock and share markets at the beginning of the week, but owing to the continued absence of selling, sentiment tended to improve. Following the Prime Minister's speech, security values were inclined to move better under the lead of British Government securities, firmness in which was assisted by the growing accumulation of funds awaiting investment. The majority of recent dividend announcements have shown the maintenance of distributions, including the interim payments of Imperial Chemical, British Aluminium and British Oxygen. Exceptionally, Associated Cement has halved its interim to 2½ per cent., which came as a disappointment to the market, where this payment was generally expected to be kept at 5 per cent. The current market view now is that, probably owing to higher production costs, the profits of cement manufacturers are not reflecting increased output. The general trend in industrial securities, however, has been fairly steady, the assumption being that in many cases, dividend payments for the current year are likely to be little changed. It is, of course, recognised that, where the E.P.T. standard is very unfavourable, lower dividends appear to be inevitable. In fact, in some instances, E.P.T. bears so heavily that it may prevent the building up of adequate reserves.

Current market expectations are that the dividend rates of many companies associated with the chemical and kindred industries are likely to be maintained. This, of course, accounts for the fact that, in most cases, the shares are valued on a low yield basis. B. Laporte, now at the higher price of 63s. 9d. yield less than 5 per cent. on the basis of last year's 15 per cent. dividend. This was, however, earned with a margin of 7 per cent.; in respect of the current year a larger capital is now in issue. A higher yield of nearly 5¾ per cent. is shown on Fison Packard ordinary, now around 35s., but this reflects the fact that last year's 10 per cent. dividend necessitated a small reduction in the balance carried forward. Imperial Chemical which at 32s. showed a small improvement over the price current a week ago, yield 5 per cent., last year's dividend having been 8 per cent., which the market remains very hopeful will be maintained.

Associated Cement, which have declined sharply to 50s. on the lower interim payment, still give a very small yield of 4 per cent. (last year's dividend was 10 per cent.), but in regard to shares of cement manufacturers the prevailing disposition is to take the long view on the assumption that, in the period of reconstruction following the war, these companies are likely to be exceptionally active and may be able to work at a higher margin of profit. The units of the Distillers Co., which have been firm at 70s., show a yield of 4⅞ per cent., and among other lower-yielding shares, Lever and Unilever return less than 4 per cent. on the basis of the 5 per cent. dividend recently declared for 1940. Elsewhere, Borax Consolidated deferred units, which at 28s. are slightly below the price current a week ago, yield 5¼ per cent., the last dividend having been 7½ per cent. Many shares of companies associated with the iron and steel industries, such as Dorman Long, Guest Keen and Consett Iron, are valued on a high yield basis, because in most instances they have a very unfavourable E.P.T. standard. Tube Investments and Stewarts and Lloyds give only moderate yields, however, because the market believes there are good prospects of dividends being maintained.

Barry and Staines ordinary shares have again been fairly active, and at 36s. were the same as a week ago, while Nairn and Greenwich were also unchanged at 61s. 3d., and awaiting the dividend announcement. Wall Paper Manufacturers deferred at 26s. 6d. were higher on balance. United Molasses had a more active appearance around 27s., while elsewhere, Triplex Glass were higher at 25s. 10½d. on the full report and accounts. Dunlop Rubber were better at 37s., but Turner and Newall had an easier appearance at 70s. 7½d. In other directions, Boots Drug were little changed at 34s. 3d. Imperial Smelting at 12s. 9d. were within 3d. of the price ruling a week ago. British Drug Houses ordinary were again 22s. 6d., Goodlass Wall around their par value of 10s., and British Glues 4s. ordinary were again around 6s. William Blythe 3s. shares, which remained firm under the influence of the higher interim dividend, were also quoted at 6s. Monsanto Chemicals 5½ per cent. preference shares kept at 22s. 6d. Murex were firm at 87s. 6d. on the maintenance of the dividend at 20 per cent.

British Chemical Prices

Market Reports

ACTIVITY in the market for general chemicals has been fairly widespread during the past week, although in a number of sections there is a scarcity of supplies to meet new business. On the whole makers' deliveries are satisfactory, and in this connection specifications have covered good volumes. Movements in the potash and soda products and the heavy acids are steady and the tone of the market continues firm with an upward tendency. Quotations for the majority of coal tar products are again firmer. Creosote oil, cresylic acid and naphthalene are particularly noted in this respect; pyridine is steady and pitch continues to be a quiet section.

MANCHESTER.—The demand for heavy chemicals on the Manchester market during the past week so far as actual new buying is concerned has been on a moderate scale, the interest of buyers being centred largely on supplies against existing commitments. Textile chemicals generally are moving into consumption in fair quantities, whilst the demand from the rubber and other leading industrial outlets has been on steady lines. Price changes on the week have been few, though the undertone is firm throughout the range. The tar products are an active market and high prices are being indicated for cresylic acid, creosote oil and the crude grades of naphthalene.

GLASGOW.—The slight improvement in the Scottish heavy chemical trade during the past week has been maintained for the whole market. Export business is still rather quiet. Prices generally continue very firm at about previous figures.

Price Changes

Arsenic.—99/100%, £36 per ton, ex store.

Creosote.—Home trade, 5¼d. to 7¼d. per gal., f.o.r., maker's works; exports, 6d. to 6¼d. per gal., according to grade. MANCHESTER: 6¼d. to 9d. per gal.

Potassium Bichromate.—Crystals and granular, 8d. per lb.; ground, 7½d. per lb., carriage paid.

Potassium Carbonate.—Basic prices for 50 to 100 ton lots; calcined, 98/100%, £58 per ton, c.i.f., U.K. port. Ex warehouse, £3 10s. extra per ton.

Potassium Prussiate.—Supplies scarce, prices nominal.

Pyridine.—90/140°, 18s. per gal.; 90/160°, 14s. MANCHESTER: 14s. to 18s. 6d. per gal.

Rosin.—26s. 6d. to 33s. per cwt., ex wharf, according to grade.

Toluol.—Pure, 2s. 5d. per gal., nominal; 90's, 1s. 10d. per gal. MANCHESTER: Pure, 2s. 5d. per gal., naked.